



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/558,367	11/29/2005	Munchiro Tada	Q91732	3745
23373 7590 06/11/2008				
SUGHRUE MION, PLLC				
2100 PENNSYLVANIA AVENUE, N.W.				
SUITE 800				
WASHINGTON, DC 20037				
EXAMINER				
AU, BAC H				
ART UNIT		PAPER NUMBER		
2822				
MAIL DATE		DELIVERY MODE		
06/11/2008		PAPER		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/558,367

Applicant(s)

TADA ET AL.

Examiner

Bac H. Au

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 May 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 21-23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 and 16-20 is/are rejected.
- 7) ☒ Claim(s) 14 and 15 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 November 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
- Paper No(s)/Mail Date 11-29-05/7-18-07/2-06-08
- 4) ☐ Interview Summary (PTO-413)
- Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group I, claims 1-20, in the reply filed on May 7, 2008, is acknowledged.

Claim Objections

2. Claim 9 is objected to because of the following informalities: Claim 9 is indicated as being dependent on claim 4 or 8. It is not possible for claim 9 to be dependent on claim 4, as "the third insulation film and the fourth insulation film" lack antecedent basis. Claim 9 will be treated as being dependent on claim 8.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 8-9 and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 8, it is not understood what is meant by "silicon atoms in the range smaller than the first insulation film, the second insulation film and the fourth insulation film".

Claim 9 is rejected due to its dependency.

Claim 13 recites the limitation "the third insulation film... and the fourth insulation film" in lines 4-5. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-4, 6-7, 10-11, and 16-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Meynen (U.S. Pub. 2003/0001282).

Regarding claims 1-4, 6-7, 10-11, and 16-20, Meynen [Figs.1-3] discloses a wiring structure wherein the wiring structure is so constituted that, in a wiring structure of multi-layered wiring in which a plurality of unit wiring structures are laminated [Paras.14-15], the unit wiring structure having at least one metal wiring and at least one metal connection plug formed by filling the metal into a wiring trench and a via hole [Fig.2] formed in an insulation film [2] on a substrate forming a semiconductor element, at least one of the unit wiring structures includes an insulation barrier layer with organic substance [1] inserted between at least one of the metal wiring and the metal connection plug [5,9], and an interlayer insulation film [2], at least a portion of a side surface of at least one of the metal wiring and the metal connection plug being overlaid by the insulation barrier layer;

wherein said insulation barrier layer further includes silicon atoms [Paras.11,22-33];

wherein said metal is copper, said metal wiring is a copper wiring, and said metal connection plug is a copper connection plug [Paras.14-15,37];

wherein an interlayer insulation film in which a first insulation film [3], a porous insulation film [2] and a second insulation film [4] are laminated in series [Paras.14-15], is formed on at least one of the copper wiring and the copper connection plug [5], at least a portion of a side surface of at least one of a wiring trench and a via hole [6] formed through the first insulation film [3], the porous insulation film [2] and the second insulation film [4] being overlaid by the insulation barrier layer including the organic substance [1], and carbon content of the organic substance being preferably larger than that of the first insulation film and the second insulation film [Paras.11,22-33];

wherein the porous insulation film is made of a porous film having relative dielectric constant no greater than 3.0 [Para.3];

wherein the insulation barrier layer further includes silicon atoms [Paras.11,22-33];

wherein the insulation barrier layer including the organic substance is made of organic substance including Si-O binding [Paras.11,22-33];

wherein the insulation barrier layer including the organic substance is made of organic substance including Silicon in the range of 1 atm % to 10 atm % [Paras.11,22-33];

wherein the insulation barrier layer including the organic substance is made of carbon, silicon and organic substance [Paras.11,22-33];

wherein both of the first insulation film [3] and the second insulation film [4] are made of the same material [Paras.35-36];

wherein both of the first insulation film and the second insulation film are made of the same material, and made of either one of SiCN, SiC, SiCNH, SiCH and SiOCH [Paras.35-36];

a wiring structure wherein the wiring structure is so constituted that, in a wiring structure with a multi-layered wiring formed in an insulation film on a semiconductor substrate [Paras.12-15], which is provided with a metal wiring including Cu as a main component formed through a porous insulation film [2] and a second insulation film [4] laid on the porous insulation film, and a first insulation film [3] formed on the second

insulation film, the first insulation film and the second insulation film, are made of the same material [Paras.35-36];

wherein the same material constituting the first insulation film and the second insulation film is made of either one of material including silicon carbide as a main component, material including silicon, nitride as a main component and material including silicon carbonitride as a main component [Paras.35-36].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 5 and 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meynen (U.S. Pub. 2003/0001282) in view of Besser (U.S. Pub. 2001/0051420).

Regarding claim 5, Meynen [Figs.1-3, paras.14-15] discloses a multilayer metallization with various laminated insulation layers used as interlayer dielectric layers, etch stop layers, hard mask layers, and porous insulation layers. Meynen does not clearly disclose the specific layers as required by the claim. Besser [Figs.11-18] more clearly discloses a wiring structure wherein an interlayer insulation film in which a first insulation film [1110], a third insulation film [1120], a fourth insulation film [1115], a (porous) insulation film [1130] and a second insulation film [1160] are laminated in

series, is formed on the copper wiring [1125], a side surface of a wiring trench [1230] formed through at least the second insulation film and the (porous) insulation film, and a side surface of a via hole [1220] formed through the fourth insulation film, a via interlayer insulation film [1120] and the first insulation film being overlaid by the insulation barrier layer [1420] including the organic substance, and carbon content of the organic substance being preferably larger than that of the first insulation film, the second insulation film and the fourth insulation film [Para.51].

Because both references teach methods of fabricating metal interconnects in semiconductor devices using a sealing insulation barrier layer, it would have been obvious to one skilled in the art to substitute one method for the other to achieve the predictable results of improving the metallization layer characteristics and device performance.

Regarding claim 8, Meynen [Paras.11,22-33] and Besser disclose wherein the insulation barrier layer including the organic substance includes silicon atoms in the range smaller than the first insulation film, the second insulation film and the fourth insulation film.

Regarding claim 9, Meynen and Besser fail to explicitly disclose wherein the third insulation film and the fourth insulation film are made of the same material. However, Meynen and Besser disclose various dielectric materials that are well-known and are suitable alternatives for uses as different functioning layers in a multilayered

metallization structure. It would have been obvious to modify Meynen and Besser to include wherein the third insulation film and the fourth insulation film are made of the same material. One of ordinary skill would have been motivated to select from a limited number of options to achieve the predictable results of having the desired sequential material layers for the desired metallization structure.

6. Claim 12 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Meynen (U.S. Pub. 2003/0001282) in view of Yang (U.S. Pat. 7132363).

Regarding claim 12, Meynen [Paras.11,22-33] discloses various materials used for the insulation barrier layer, including materials with compositions of $\text{Si}_a\text{O}_b\text{C}_c\text{H}_d$. Hence, Meynen discloses wherein the insulation barrier layer including the organic substance is made of a Divinyl Siloxane Benzo Cyclobutene film.

Alternatively, Meynen fails to explicitly disclose wherein the insulation barrier layer including the organic substance is made of a Divinyl Siloxane Benzo Cyclobutene film. However, Yang [Col.4 lines 19-54] discloses Divinyl Siloxane Benzo Cyclobutene as a known and suitable alternative to numerous dielectric material used in forming metallization layers. Because both references teach methods of fabricating metal interconnects in semiconductor devices using a sealing insulation barrier layer, it would have been obvious to one skilled in the art to substitute one method for the other to achieve the predictable results of improving the metallization layer characteristics and device performance.

Allowable Subject Matter

7. Claims 14 and 15 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: Prior art does not fairly disclose or make obvious the claimed structure taken as a whole, specifically, the limitations of

wherein the insulation barrier layer including the organic substance is made of a film of Divinyl Siloxane Benzo Cyclobutene, the first insulation film is made of a SiCN film, the second insulation film is made of a SiO₂ film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a porous SiOCH film, and the fourth insulation film is made of a SiO₂ film; and

wherein the insulation barrier layer including the organic substance is made of a film of Divinyl Siloxane Benzo Cyclobutene, the first insulation film is made of a SiCN film, the second insulation film is made of a SiO₂ film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a nonporous SiOCH film, and the fourth insulation film is made of a SiO₂ film.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bac H. Au whose telephone number is 571-272-8795. The examiner can normally be reached on Mon-Fri 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Zandra V. Smith/
Supervisory Patent Examiner, Art
Unit 2822

/B. H. A./
Examiner, Art Unit 2822